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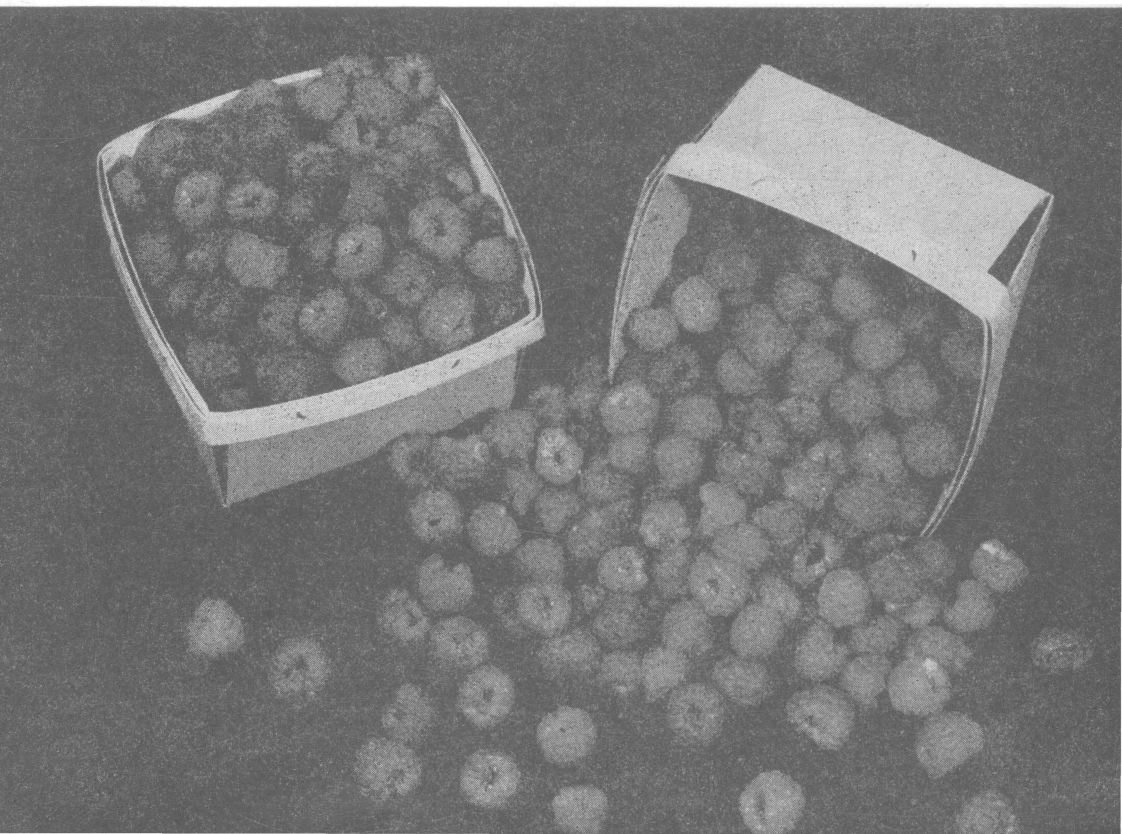
GROWING Small Fruits COMMERCIALLY IN OHIO

Agricultural Extension Service
The Ohio State University



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Growing Small Fruits Commercially

by Vernon Patterson, Extension Horticulturist*

MANY different kinds of berries, such as strawberries, red and black raspberries, grapes, currants, gooseberries, and blueberries, can be grown successfully in Ohio. The many towns and cities in the state offer fine local market possibilities for alert fruit growers who wish to raise these crops. The large number of home freezer units, as well as frozen food locker plants, have increased appreciably the demand for strawberries and raspberries. A properly managed berry planting can give a high profit per acre and may be of value for diversifying the farm program.

Small fruits are not difficult to grow but the greatest success is attained when adequate attention is given to site and soil, variety selection, and to the various cultural operations. This bulletin is intended to supply the commercial grower with condensed information on berry culture.

PLANNING AND PLANTING

Before berries are planted, the grower should consider carefully the location and arrangement of the planting. If properly planned, the berry enterprise may be arranged to fit in with other farm activities and provide diversification, which does not seriously compete with other jobs for labor or equipment.

If the planting is to be cultivated and the site is on sloping land, the rows should run along the contours of the slopes to reduce erosion.

In all cases, berry plantings should be rotated to new land that has not recently produced the same crop. If one type of berry is repeatedly grown on the same site, insect and disease problems may become serious and nutritional disorders may develop.

Climate, Site, and Soil

With the exception of boysenberries, dewberries, and other trailing brambles, the varieties of small fruits described in this bulletin are quite hardy and well adapted to the climatic conditions of Ohio.

Small fruits should be planted on elevated, sloping land that is free from frost pockets. Fertile soil, well drained to a depth of

* Original manuscript for this publication written jointly with Wesley P. Judkins now chairman of the Department of Horticulture, Virginia Polytechnic Institute.

at least 2 feet, is best for most berries. If there is any question about the drainage condition of a soil, a trench should be dug or samples secured with a soil auger or tube. Well drained soils exhibit a rather uniform brown color. Poorly drained soil will have gray and black mottled areas.

Blueberries require an acid soil (pH 4.0 to 5.0) containing a liberal amount of organic matter and a good moisture supply throughout the season. The acidifying of soils too alkaline for blueberries is discussed in the section on soil acidity and liming. The use of mulch to conserve soil moisture is described in the section on cultural practices.

Planting Season

Berry plants should be set out just as early in the spring as the ground can be prepared. Autumn planting at about the time of the first frost may give good results but some plants may be killed, if a severe cold winter follows. Also, on heavy soils, some fall-set plants may be heaved out of the ground by alternate freezing and thawing. Autumn planting should be delayed until adequate rain has fallen to provide good soil moisture conditions.

Fall planting of strawberries is not recommended for they usually produce only a 10 to 20 per cent crop the following June because no runner plants have been established. Since the plants should be protected with mulch during the winter to prevent injury by cold and heaving, the fall-planted bed must be mulched for two winters before a full crop of fruit can be expected.

Planting Distances and Yield Data

The planting distances given in Table 1 indicate minimum distances when small garden tractors or single horse cultivators are used. The maximum spacings are necessary in commercial

Table 1.—Planting distance, yield, duration of plantings, and plants needed per acre of berries in Ohio

	Planting Distance		Plants per acre*	Yield per acre	Life of plants
	Between rows Ft.	In the row Ft.		Quarts	Years
Strawberry	3½– 4½	1½	6,450–8,300	2,000–5,000	2– 3
Black raspberry.	6 – 9	2	2,400–3,650	1,500–3,000	8–10
Red raspberry..	6 – 9	2½	1,950–2,900	1,000–2,000	8–10
Purple raspberry	6 – 9	2½	1,950–2,900	2,000–3,200	8–10
Blackberry	7 –10	3	1,450–2,100	2,000–4,000	10–12
Currant	6 – 8	5	1,100–1,450	3,000–5,000	12–15
Gooseberry	6 – 8	5	1,100–1,450	3,000–5,000	12–15
Blueberry	6 –10	5	850–1,450	1,500–3,000	30–50
Grape	6 –10	7–9	500–1,000	2,000–4,000	25–30

* The number of plants required to plant an acre may be determined accurately by multiplying the distance in feet between rows by the distance between plants in the row and dividing the result into 43,560, the number of square feet in an acre.

plantings where tractors and standard farm implements are used in the cultural operations.

The yield data of Table 1 are intended to indicate average production on good soils when approved cultural practices are followed. Under poor conditions, yields may be considerably lower, and in favorable seasons the production may be somewhat higher.

Precautions

Black raspberries should be located at least 300 feet from red raspberries to reduce the spread of virus diseases from the red to the black varieties. Strawberries should not be set in soils where previous plantings have been injured by red stele disease.

Duration of Planting

The average productive life of various berries is indicated in Table 1. Attacks of diseases or insects, or unfavorable growing conditions, may make a berry planting worthless at a younger age than is indicated in this table.

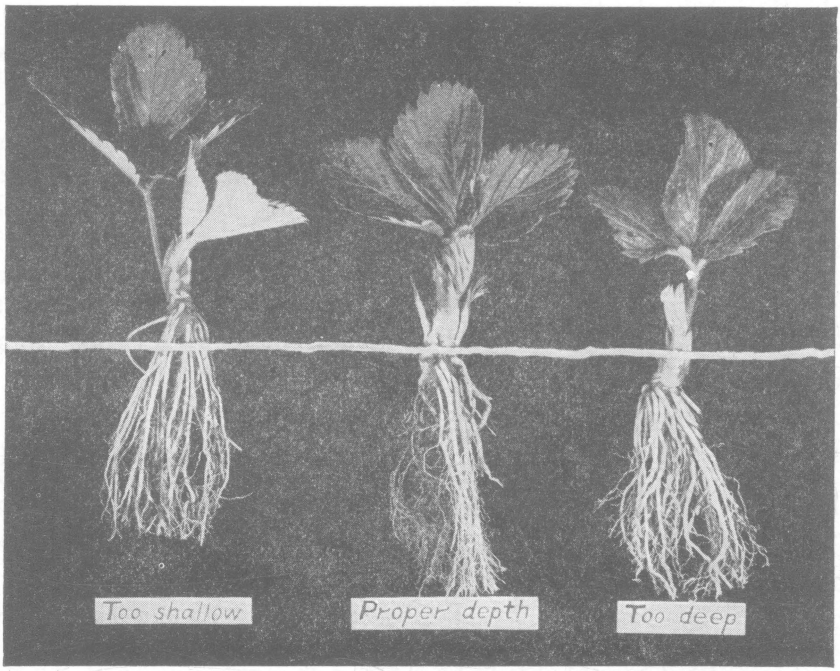
Setting the Plants

Small fruit plants should be set in a well prepared soil, preferably one that was occupied by a vegetable garden or other cultivated crop for 1 or 2 years. Weed control is easier in such a soil, and damage by white grubs is usually much less than when plants are set on land that was in sod the previous year.

In loose soils, a sufficiently large hole may be made for small-rooted plants by inserting a shovel deeply into the earth and moving it back and forth to make a V-shaped opening. In heavier soils, or with large plants, a hole should be dug to receive the roots. In all cases the roots should be carefully spread out to insure a quick resumption of growth.

Best results will be obtained if plants are set out as soon as they are received from the nursery. If the soil is dry, it is advisable to apply water around the roots at the time of planting. If the plants must be held for several days before they can be planted, they should be placed in a cool storage and the packing material kept in a moist condition.

If a suitable storage is not available, the plants should be heeled-in outdoors until they can be planted in their permanent location. The heeled-in plants are laid in a closely packed single row in a shallow trench with the roots thoroughly covered with moist soil. If the weather continues to be unfavorable, the plants will remain in good condition for several weeks.



Strawberry plants illustrating proper and improper planting depths.

Strawberries should be set firmly in such a way that all the roots are below the ground and yet no soil is over the crown of the plant. This can be easily seen in the accompanying illustration. If soil is washed over the crown by a heavy rain, it should be removed within a few days to avoid smothering the plant.

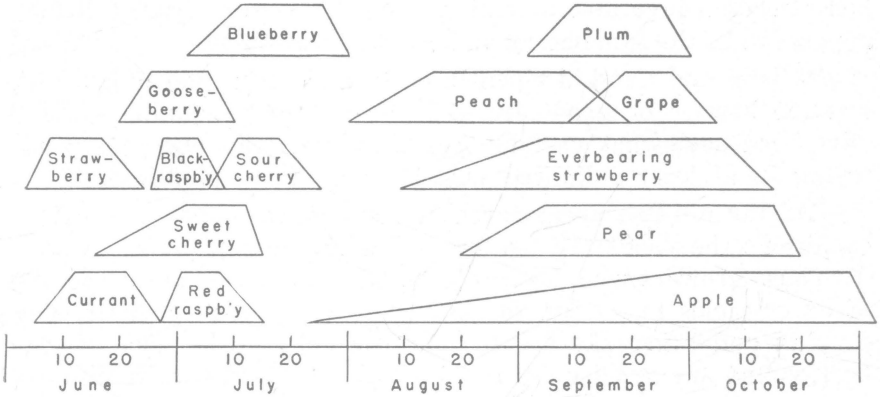
Raspberries, blackberries, grapes, and blueberries should be set slightly lower than they were in the nursery. Currants and gooseberries should be set with the base of the lower branches just below the surface of the soil to encourage the development of a bush rather than a tree type plant. Broken and diseased roots should be removed and long rangy branches should be cut back.

In **black** and **purple** raspberries that are propagated by tip-layering, the "handle" or short section of the parent cane should be removed at planting time, because it is frequently a source of anthracnose infection. This is an important operation and should not be neglected.

VARIETIES, POLLINATION, AND PROPAGATION

Varieties

The best small fruit varieties are those that are productive, dependable, of high quality, and relatively resistant to insects and

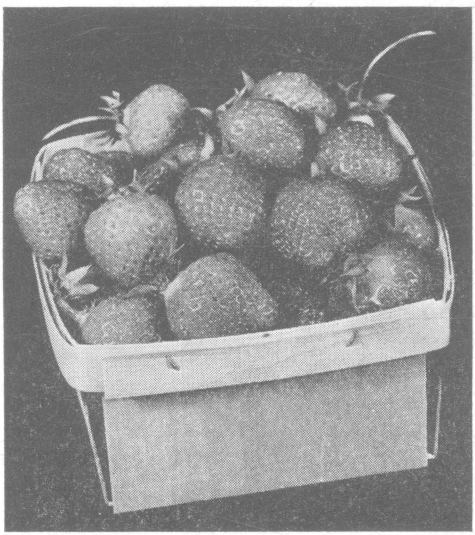


Ripening season for different fruits at Wooster, Ohio.

diseases. If the commercial planting is to be profitable, the importance of selecting good varieties cannot be over-emphasized.

Careful selection of varieties will help maintain a continuous supply of fruit on a roadside or local market. The diagram above indicates the approximate ripening season of important fruits at Wooster, Ohio. Ripening dates in the southern part of the state are usually a week or two earlier than those cited for Wooster, while dates for northern Ohio would be a few days later.

Results of fruit variety tests are published from time to time in *Farm and Home Research,* the bimonthly bulletin of the Ohio Agricultual Experiment Station.



Premier is the most dependable and productive strawberry in Ohio.

Strawberry—June-Bearing Varieties

Premier (Howard 17) has been the leading early-ripening strawberry variety for many years and still maintains this favored position in most parts of Ohio.

Blakemore is a standard variety in southern Ohio but forms an excessive stand of runner plants in the regions farther north. The fruit is of average size and quality, and is sufficiently firm to be an excellent shipper.

Robinson, a large, productive, midseason variety,

has attracted favorable attention in recent years. **Scarlet Beauty** appears to be the same berry under a different name.

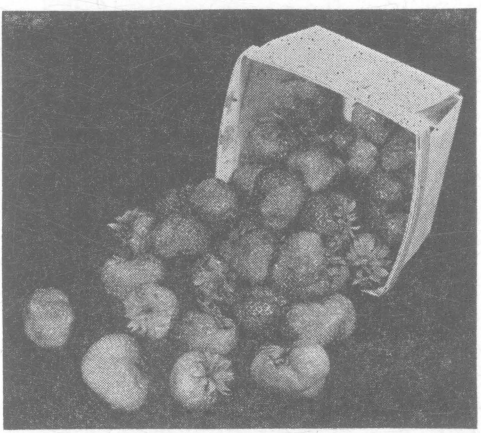
Midland and Catskill ripen in early midseason and produce attractive berries of good size and above average quality. Yields have been somewhat variable but these varieties are well worth trying in at least a limited way in commercial plantings.

Redstar and Chesapeake are late ripening varieites. Under most conditions the yields are too low to justify their planting in Ohio.

Those growers who desire high quality berries even at the cost of lower yields may wish to plant **Dorsett, Fairfax** or **Fairpeake.** Fairfax and Fairpeake are too dark in color to be good market berries and are not usually rated among the best for freezing.

Strawberry—Varieties Resistant to Red Stele

Red stele, a serious fungus disease, frequently causes serious losses in Ohio. This disease usually becomes evident in the spring of the first fruiting year. The tops of the plants die as a result of rotted, non-functional roots. The best control measures are the planting of resistant varieties on well drained fertile soils.



Gem has been the best everbearing strawberry variety in the sawdust-mulch system of management. The berries are fine for freezing.

Fairland is a new early midseason variety reported to be commercially resistant to red stele and adapted to Premier territory.

Sparkle is a midseason variety that ripens over a long period and appears to be quite resistant to red stele. The fruits are bright red, of good size and fine for freezing.

Temple is likewise resistant to red stele but has not been very productive under Ohio conditions.

Strawberry—Everbearing Varieties

As a rule everbearing strawberries have not been very satisfactory as a commercial crop in Ohio. During recent years, however, the sawdust-mulch, spaced-plant system has given excellent results in a number of plantings. This system is described on pages 20, 21, and 22.

Gem is the preferred everbearing variety because it has been the most productive during the late summer and autumn period. The berries are fine for freezing. Gem produces an adequate number of runner plants for training by the sawdust-mulch system.

Gemzata produces a large crop in June but the fall crop is considerably less than Gem.

Green Mountain will produce a crop in June nearly as large as can be expected from such varieties as Premier or Catskill. The fall crop is usually quite small and the fruit is only average in quality.

Black Raspberry Varieties

Logan and **Bristol** are early ripening varieties seemingly superior in yield and quality to **Cumberland**, that has been a standard variety in commercial plantings for a number of years. Logan is now producing fine crops in many commercial plantings in Ohio. In a somewhat limited number of trials, Bristol seems superior to Logan and may eventually replace this latter variety.

Morrison and **Naples** ripen a little later than the above-named varieties and may have limited value to extend the picking season. These late ripening black raspberries are less productive than the earlier types.

Red Raspberry Varieties

Latham (midseason) continues to be the best red raspberry for planting in Ohio. It should be selected as the principal variety in all commercial plantings.

Taylor (midseason) is somewhat higher in quality and less susceptible to crumbling than Latham. In most tests, Taylor has not proved to be as productive and hardy as Latham.

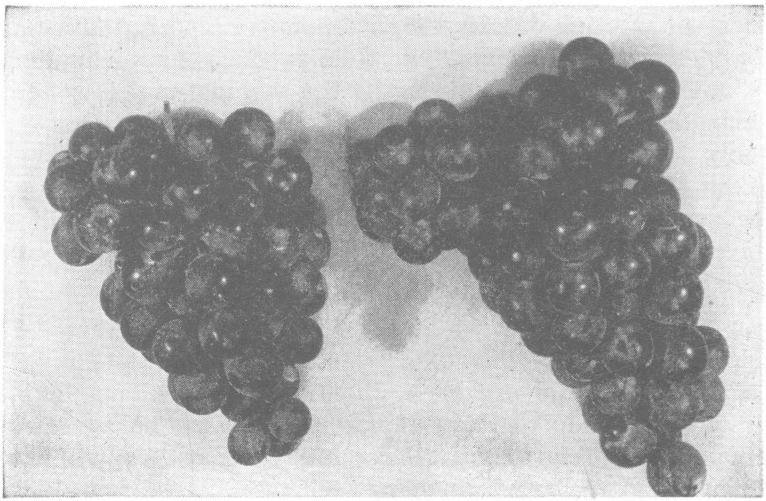
Sunrise (early), **Milton** (late), and **Indian Summer** (everbearer) may be useful for extending the harvesting period.

Purple Raspberry Varieties

Sodus and **Marion** are the preferred varieties of purple raspberries. They have replaced Columbian because of greater resistance to mosaic.

Blackberry Varieties

Eldorado (early midseason) is the best blackberry for Ohio. **Alfred** (early) and **Ward** (late) may also be planted to extend the picking season.



Concord, the standard blue grape of Ohio.

Grape Varieties (American Types)

Concord (blue, midseason) is without question the most important grape in Ohio. The fruit of Concord is suitable for use as a dessert grape, as well as for jelly, jam, juice, or wine.

Fredonia is a desirable blue grape, ripening about 10 days before Concord.

Sheridan is a fine blue grape and ripens about a week after Concord. Due to its late ripening season, Sheridan will not ripen properly in most sections of Ohio.

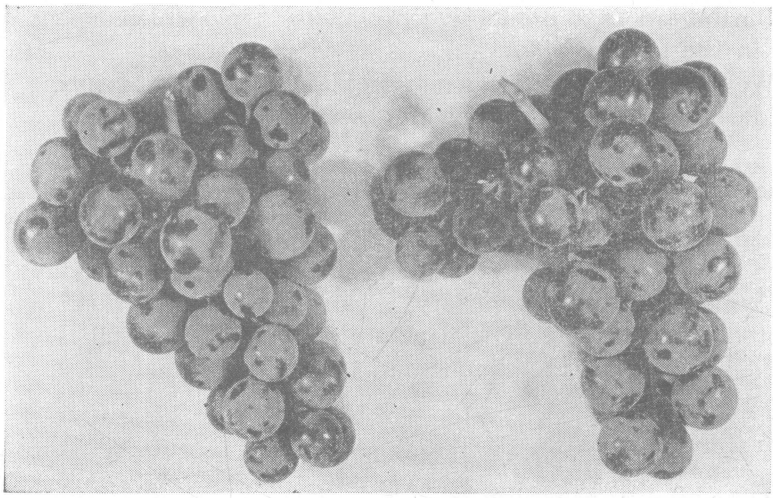
Niagara is the standard white grape that ripens in midseason with Concord. White grapes have a more limited usefulness than blue grapes since they are not usually considered desirable for juice, jelly, or jam. Niagara is less hardy than Concord and more susceptible to fungus diseases.

Delaware is a standard, red, midseason variety of very high dessert quality. Delaware is suitable for juice and is highly prized for making fine wine and champagne. The vines of Delaware are slow growing, and because of the small size of the clusters, the yield per vine or per acre is not equal to other standard varieties.

Catawba is a red grape requiring a long growing season. It is produced in the Sandusky area and on the islands of Lake Erie just north of Sandusky.

Van Buren is a promising early blue grape.

Dunkirk is a new midseason red variety that is recommended for trial.



Dunkirk, a promising new red grape.

The **European type grapes (Vitis vinifera)** commonly grown in California, are not adapted to the climatic conditions of Ohio. Varieties of this type are too tender to withstand cold winter temperatures. In addition, phylloxera and mildew cause serious losses and make these grapes unprofitable.

Certain hybrid types, resulting from crosses of American and European varieties, offer some promise but more tests are needed before they can be recommended for general planting.

Currant Varieties

Wilder (midseason) and **Red Lake** (late) are the preferred types of currants for Ohio.

Gooseberry Varieties

Poorman is the best red fruited gooseberry for Ohio.

Downing should be planted, if a green fruited variety is desired.

Blueberry Varieties

Jersey, a late midseason variety, is probably the most desirable general purpose blueberry for Ohio.

Stanley is a dependable midseason blueberry. The skin around the scar tears rather badly when the fruit is picked, thus reducing its keeping and shipping quality.

Dixi is a late midseason variety with exceptionally large fruit. The skin of this berry also tends to tear around the scar.

Atlantic and **Pemberton** are promising new late ripening varieties.

Burlington is a productive promising type which ripens very late in the season.

Weymouth and **Rancocas** may be planted, if early maturing sorts are desired to extend the picking season.

Elderberry Varieties

Elderberries harvested from plants growing in woodlots and fence rows have for many years furnished fruit for pies, jelly, jam, and wine. The **Adams** variety, a large-fruited selection, may be planted, if the supply of wild plants is inadequate to fill the needs of the area where the commercial grower is located.

Bush Cherry Varieties

The Nanking cherries, as well as the Korean and Hanson hybrid types, have aroused considerable interest in recent years. The plants are shrublike in growth and quite hardy. The fruit of most varieties is small and tart, and the seeds may be rather large in proportion to the size of the fruit.

Although the fruit of the bush cherry may be used for culinary purposes, the principal value of these plants seems to be as an ornamental shrub. The flowers and fruit are attractive in season and the leaves of many varieties turn bright red in autumn.

Boysenberry, Loganberry, Dewberry, and Youngberry Varieties

Boysenberries are not a satisfactory crop for Ohio. The canes are very susceptible to killing by cold winter weather. The trailing, thorny canes need to be trained along a trellis or fence and this is a laborious precedure, at best. In addition to these faults, boysenberries are very susceptible to crown gall. This disease may entirely destroy a planting in 1 or 2-year's time.

Although boysenberry fruits are large and attractive, they are sour and poor in quality unless thoroughly ripened before being picked. Furthermore, the final ripening process proceeds rapidly and the berries become soft and unpalatable in a short time, unless they are picked immediately.

All factors considered, the berry grower will usually derive much more profit from raspberries or blackberries than from boysenberries.

Loganberries, dewberries, and youngberries have many of the weaknesses of boysenberries and are not adapted to Ohio conditions.

Pollination

Pollination is the transfer of pollen from the anthers to the stigmatic surface of the flower. The flowers of fruit plants must be pollinated, if the small ovulary is to grow into an edible fruit. Insects, especially bees, must be present if pollination is to take place. In addition, the weather must be warm and sunny for at least a few hours because insects are relatively inactive during cold rainy weather.

Blackberries, raspberries, currants, gooseberries and elderberries are for the most part self-fruitful. In other words, the pollen of each flower is capable of fertilizing the small ovulary of the same flower, or the flowers of other plants of the same variety. In self-unfruitful species this is not true, and two or more different varieties must be planted to provide for cross-pollination.

The important **grape** varieties are self-fruitful. Many of the old varieties have been discarded because of sterile pollen or reflexed stamens, which are ineffective in pollination. The grower should consider this matter of pollination before planting old or unknown varieties of grapes.

The important **strawberry** varieties have perfect flowers and need no provision for cross-pollination.

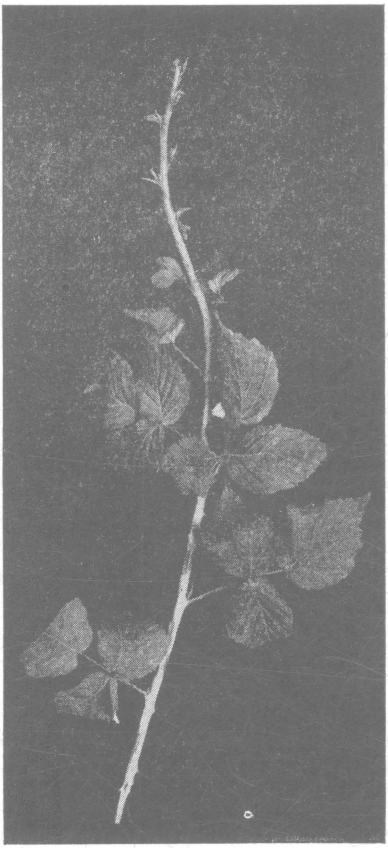
Most **blueberry** varieties appear to produce satisfactory crops of fruit when planted alone and without provision for cross-pollination. Some workers have reported that yields have been increased when several varieties are interplanted. Since most growers will desire more than one variety to provide an extended picking season, it is advisable to have at least two varieties in the planting to insure pollination. Two rows of one kind followed by two of another is the usual recommendation.

Bush cherries are largely self-sterile and at least two varieties should be planted to provide for cross-pollination.

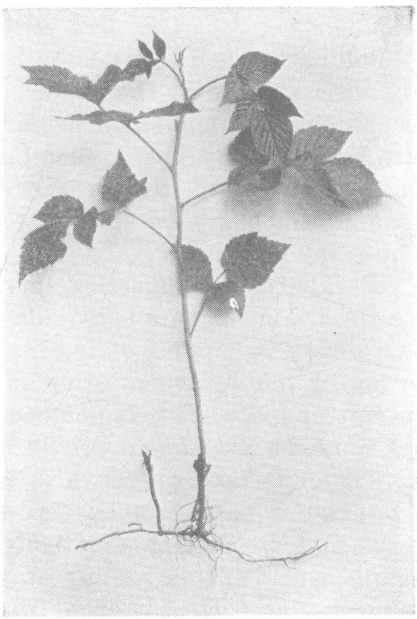
Propagation and Selection of Plants

As a rule, most commercial growers should purchase well grown, healthy, 1-year-old plants from a nursery rather than attempt to produce their own. However, some growers find the production of plants a profitable sideline. If care is taken to keep diseases and insects under control, good plants can be produced satisfactorily from berry plantations located on a good soil.

Strawberries are propagated from runner plants formed during the summer. Only vigorous, well rooted, 1-year-old runner plants should be used in setting a new patch. Never use the 2-year-old original plants of the old planting.



Black raspberry cane with elongated tip ready for layering.



Red raspberry plant ready for transplanting.

Red raspberries are propagated by suckers or shoots that arise from underground stems around the parent plant. In late fall or early spring these young plants can easily be transplanted. It is preferable to retain as many roots as possible and keep the plants moist at all times. Plants of **purple raspberries** and **blackberries** may also be secured in this way.

The **black,** and most of the **purple raspberries,** are propagated by tip-layering. When the tips become elongated and light in color, in late August, they are inserted vertically into the soil to a depth of 3 to 4 inches. The easiest method is to thrust a small pointed shovel into the ground, move back and forth to make a V-shaped opening, insert the elongated end of the cane, and firm the soil around it by tramping with the foot. The young rooted plant is ready for transplanting during the usual autumn or spring planting season.

When **blackberry** plants are desired in large numbers they are propagated by root cuttings. For best results, the roots should be about ¼ inch in diameter. The roots are dug in the fall, cut in pieces about 3 or 4 inches long and buried outdoors in moist

sand in a well drained location. In spring, the cuttings are planted 3 to 6 inches apart in furrows 2 or 3 inches deep. The cuttings may be taken in the spring and planted immediately, but autumn is the preferred season for this operation.

Grapes and **currants** are propagated from cuttings of dormant canes of the previous year's growth. Cuttings should be about 8 to 10 inches long and taken during the winter from canes that are about ¼ inch in diameter. These sticks are then tied in bundles of any convenient number and buried top-end down in moist moss in a cool storage. The cuttings should contain at least three nodes so one can be in the soil and one above ground when the cuttings are planted in the nursery row. In spring, the cuttings are planted firmly in the soil 6 to 8 inches apart, in rows 3 feet apart. Grapes may be propagated by layering, if only a few plants are needed.

Gooseberries are ordinarily propagated by mound layering. This procedure consists of cutting back all branches in early spring to leave stubs about 3 to 4 inches long. In July, the vigorous shoots that develop are mounded up about half their length with earth. The rooted shoots thus secured may be moved and transplanted in the fall or spring. Gooseberry plants may be secured by layering, if only a limited number are desired.

Blueberries are usually propagated from cuttings taken in late April and rooted in ground peat moss. Special care is needed to insure success. The grower desiring to produce blueberry plants should study detailed directions before starting this phase of berry production.

It is usually better for the commercial grower to purchase 2- or 3-year-old blueberry plants than to attempt to produce his own.

SOIL MANAGEMENT AND CULTURAL OPERATIONS

Soil Acidity and Liming

Berry plants are tolerant of a wide range of acidity, but it is nevertheless important that the pH value of the soil be maintained with the optimum range indicated by the following figures.

	Optimum pH range
Strawberry, black raspberry, gooseberry	5.0–6.5
Red raspberry, currant, grape	5.5–7.0
Blueberry	4.0–5.0

Cover crops usually grow best in soils with a pH of 6.0 to 6.5. Therefore, it is desirable to add lime to bring the soil to this ap-

proximate value (except for blueberries) even though the berry plants may not be directly benefited by such a practice. On sandy soils, about 1 ton of ground limestone is needed per acre to raise the soil 1.0 pH in value, about 2 tons is needed on silt-loam soils, and about 2.5 tons on clay-loam soils.

Blueberries require an acid soil. If the site has a pH value higher than pH 5.0, it may be desirable to increase the acidity by applying sulfur. On sandy soils use ¾ pound sulfur per 100 square feet for each 1.0 pH over 4.5. For example, a sandy soil with pH 6.5 would require 1½ pounds of sulfur per 100 square feet. A silt loam soil would require about 1½ or 2 pounds of sulfur per 100 square feet for each 1.0 pH over 4.5. Heavier soils require even more but blueberries should not be planted on heavy clay soils.

FERTILIZATION

Raspberry, Blackberry, Grape, Currant, and Gooseberry

Most berry crops will give increased yields if 6 to 8 tons of cow or horse manure are applied per acre. Poultry manure may be used at the rate of 2 or 3 tons per acre. If manure is not available, an application of 300 pounds per acre of commercial fertilizer containing 20 per cent nitrogen may be used. If fertilizers, such as ammonium nitrate (32 to 34 per cent nitrogen) or urea (46 per cent nitrogen), are used, the amount applied per acre should be reduced to the equivalent of 300 pounds of a 20 per cent fertilizer. The fertilizer or manure should be applied in early spring just before growth starts.

If a mulch of straw or other organic material is used around the berry plants, it is especially important that a nitrogen fertilizer be applied during the first few years when the mulch system is being established. Such a practice prevents the development of a deficiency of soil nitrogen that may occur when the soil bacteria tie up the available nitrogen during the process of decomposing the organic matter.

Strawberry

The largest yields of strawberries will be secured on fertile soils that have received an application of 8 to 10 tons of manure per acre at the time the land is prepared for planting. The use of commercial fertilizers on strawberries has given inconsistent

results. In some cases, experimental plots and growers plantings have benefited from 100 pounds per acre of a 20 per cent nitrogen fertilizer, or its equivalent, applied as a side-dressing during the first growing season. In other cases no increases in yield are secured by such a practice.

The grower should conduct tests on a few rows at the edge of his planting to determine how well the plants will respond to fertilizer treatment on his particular soil. Some tests indicate that the best results may be secured by applying the fertilizer in late May or early June, about a month or 6 weeks after the plants are set in the field. Other trials indicate that the best time is in early August when the runner plants are taking root in appreciable numbers.

As a rule, nitrogen fertilizer should not be used around strawberries in the spring of the fruiting year, as it may delay ripening and cause soft berries.

There is some indication that the use of 200 to 400 pounds of superphosphate per acre, applied on top of the mulch in February, may improve yields of strawberries.

Blueberries

Blueberries should be fertilized with a 8–8–8 or 4–12–8 fertilizer applied at the rate of 1 ounce per year of plant age until a total of 8 ounces per plant is being used.

Cultural Operations and Mulching

Raspberry, Blackberry, Grape, Currant, Gooseberry, and Blueberry

The bush and cane type berry plants are usually cultivated during the early part of the growing season. A summer cover crop of soybeans may be planted between the rows in early July. In September or early October a winter cover crop of wheat or rye should be planted. These cover crops help maintain organic matter in the soil and reduce erosion.

The use of mulch, such as straw, old hay, sawdust, or other organic material, is an excellent practice for most bush type berry plants. Such a mulch reduces erosion, conserves moisture, eliminates the need for cultivation, and promotes good growth and yields. The principal difficulty may be in securing an adequate supply of mulching material at a reasonable price. About 8 tons of straw are required per acre for the original application, followed by 3 tons each succeeding fall to maintain the mulch at a sufficient depth to suppress the growth of grass and weeds.

Black raspberries under straw-mulch system of management.

A mulch of sawdust or peat moss is especially beneficial around blueberries to promote a good soil condition throughout the growing season.

On light, infertile soils, nitrogen deficiency may develop when mulches or organic materials are used around plants. This condition may be corrected by using nitrogen fertilizer.

Mice may damage berry bushes when straw mulch is used around the plants. If such damage occurs, poison bait should be distributed to reduce the mouse population. A rodenticide containing phosphorus may be secured from the county agent for use in controlling this pest.

Cultural Practices for Strawberries

The strawberry planting should be cultivated and hoed repeatedly throughout the growing season. Weeds and grass must be controlled, if large crops of easily harvested berries are to be produced.

Mulching Strawberries.—In late November or early December, a mulch of straw should be placed over the entire plantation. The best time to apply the mulch is after the plants have been hardened-off by a few sharp freezes, and when the ground is frozen to a depth of 1 or 2 inches. The mulch should be applied before the real cold winter weather occurs, because unprotected strawberry plants may be injured if the temperature drops below 20 degrees Fahrenheit.

In southern Ohio, the mulch should be about 2 inches thick. This will require about 2 tons of straw per acre. In northern

The straw mulch left between the matted rows of strawberries helps conserve soil moisture, suppresses weed growth and prevents dirt from splashing on the ripening fruit.

Ohio, a heavier mulch of about 3 to 4 tons per acre seems more desirable.

The mulch is removed from the plants in mid-April when growth starts and the young center leaves begin to turn yellow. The mulch should be left between the rows to suppress weeds, conserve moisture, and prevent the berries from becoming dirty from contact with the soil.

Some growers have used sawdust as a mulch on June-bearing varieties but in most cases it would not be as economical as straw.

Blossom Removal from Strawberries.—Most strawberry plants have young flower buds in the crown at the time they are set out in the spring. These buds develop into flowers, and if allowed to ripen a crop of fruit, may prevent the young plant from making satisfactory growth and thus may limit the number of runner plants that are established. A good stand of runner plants is essential if large yields of berries are to be secured.

The flowers should be removed from June-bearing strawberries at least 3 or 4 times during the first 6 or 8 weeks after the plants are set in the field. This removal is especially important, if the plants lack vigor or if the soil is infertile or lacking in moisture. In the case of everbearing varieties the blossoms should be picked off until mid-July and then allowed to develop into fruit for the fall crop.

Renovating Strawberry Plantings.—Most commercial growers in Ohio pick only one crop of strawberries and then destroy the planting. The difficulty of controlling weeds in a 2-year-old straw-

berry bed, plus the smaller size of the berries produced, seems to justify such a procedure in the majority of cases.

However, strawberries located on a good soil, free from weeds and damage by insects and diseases, may produce as large a second crop as a 1-year-old patch, if proper renovation practices are followed. The berries may be somewhat smaller in size than the first crop, but frequently give the grower a nice profit for his effort.

The first procedure to follow in renovating a strawberry planting is to mow the entire bed. This practice is especially important, if the patch contains many weeds that have developed during the picking season. If a heavy mulch has been used, or if weed growth is abundant, the straw and mowed material may have to be removed. If it is left in the field it may interfere with the cultural operations to follow.

The next step is to thoroughly cultivate the planting and reduce the width of the matted rows to about 15 or 18 inches. The patch is then handled like a first-year bed for the remainder of the season. The drastic renewal systems, commonly recommended in the past, are unnecessary. They frequently reduce rather than increase the size of the second crop.

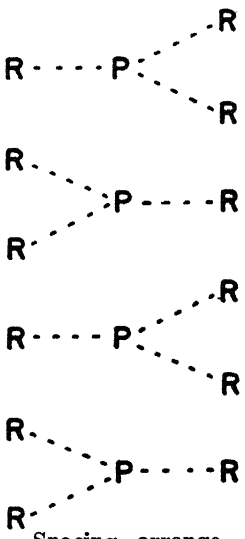
Sawdust-mulch System for Everbearing Strawberries.—For decades, fruit growers have been advised they should not raise everbearing strawberries. The venture was almost invariably destined to fail. With the recent development of the sawdust-mulch and spaced-plant system, the picture has been entirely changed.

Gem everbearing strawberries under sawdust-mulch system of management.

Fine profits can be derived from everbearing strawberries by the grower who will carefully follow this method of production.

Credit for developing this system of strawberry production belongs to Karl Michener, of Burton City, Ohio. Plants of Gem everbearing strawberries are set 15 inches apart in rows 42 inches apart, as early in the spring as the land can be prepared. The bed is cultivated several times until early June. By that time runners should be developing rapidly. Cultivation is discontinued and the entire area is covered with about 1 inch of sawdust.

As soon as the mulch has been applied, the training of the runners should begin. Under the Michener system three runner plants are rooted from each parent plant, as indicated in the accompanying diagram. A triple row is established from each original single row. The side plants are forced gently but firmly through the sawdust until the young roots are in contact with the soil. Each row of young plants is established 10 or 12 inches to the side of the center or parent plant row. The pattern of arrangement of parent and runner plants is illustrated in the diagram.



Spacing arrangement for parent (P) and runner (R) plants in the sawdust-mulch system of raising everbearing strawberries.

After the desired number of runner plants have been established, all additional runners are removed during the remainder of the growing season. Weeds must be controlled by hoeing or by being pulled out by hand, because the rows are now so close together that mechanical cultivation is impossible and the mulch should not be disturbed.

Hardwood sawdust is preferred, because in a few cases, where fir or pine material has been used, the plants have been injured. Sawdust does not make the soil acid as is sometimes thought. In some instances, a temporary nitrogen deficiency may develop in the soil, but this can be remedied by the use of a quickly available nitrogen fertilizer.

About 140 cubic yards of sawdust are needed to apply a 1-inch layer over 1 acre of land. If the sawdust is dry it will weigh 15 to 20 tons. If wet, green sawdust is used, the 140 cubic yards may weigh 40 tons or possibly more.

All blossoms should be removed until about mid-July of the fruit growing season. Such a practice allows the plants to become well established and send out vigorous runners before the fruit crop is

produced. The first fruits will mature about the second week in August. Ripe berries are picked twice each week during August and September and once a week in October. Berry production continues until growth is stopped by frost.

Additional details concerning this system of producing everbearing strawberries may be secured by writing to the Department of Horticulture, Ohio Agricultural Experiment Station, Wooster, Ohio.

Irrigation

Rainfall in Ohio is frequently inadequate during some part of the summer to promote optimum growth and fruitfulness of berry plantings. For this reason, the grower should consider seriously the possibility of irrigation, especially if his soil is sandy or shallow and is thus of a drouthy nature.

Water should be applied to the soil when the moisture content approaches the wilting point. It is difficult for the grower to make accurate determinations of soil moisture and, therefore, a "rule of thumb" procedure is usually followed.

Under average conditions in Ohio, shallow-rooted plants, such as strawberries, require about 1 inch of rainfall per week, if optimum growth is to be secured. Therefore, whenever the rainfall during the growing season is less than 1 inch per week, extra water should be applied. During hot, sunny periods, or on sandy soils, an even larger amount of irrigating may be necessary.

An overhead or sprinkler system is probably the most desirable in berry plantings. If the strawberries can be rotated with vegetables or other crops that benefit by irrigation, a permanent system of overhead pipes may be installed.

If the planting is to be moved frequently, a portable system using lightweight galvanized tubing with quick-action couplings may be preferable. At the present time, rotating sprinkler heads that will throw water to a distance of about 200 feet are available and thus several acres can be irrigated from a single nozzle. Also smaller sprinklers that operate with less volume and pressure of water are available.

One of the most serious limiting factors in establishing an irrigation system is the water supply. For example, 1 inch of water over an acre of land is known as an acre-inch and requires 27,150 gallons. As a rule, enough water should be applied at each irrigation to soak rather thoroughly the entire depth of soil occupied by the roots of the plants. Usually, at least a half-inch of water should be used. If a large acreage is to be irrigated, it is easy to

understand that a good sized reservoir, creek, or well of large capacity must be available.

PRUNING AND TRAINING

The pruning of small fruits is not difficult but it is one of the most necessary operations. Detailed directions for performing this job can be found in the bulletin on the pruning of small fruits, available from the Agricultural Extension Service, Ohio State University, Columbus 10, Ohio, or from the county agent's office.

DISEASE AND INSECT CONTROL

Instructions for the control of diseases and insects in berry plantings will be found in the spray program and pest control bulletin. A copy of this publication may be obtained from the county agent in the locality where the grower lives.

HARVESTING

Berries should be picked in as ripe a condition as is consistent with the type of handling and shipping they are to receive before reaching the consumer. Commercial growers, who sell on a local market or roadside stand, should allow the fruit to reach nearly full maturity so the customer will receive a high quality product. Home gardeners, likewise, should allow the fruit to become fully mature before it is picked.

The determination of optimum maturity is largely a matter of experience on the part of the grower. As the fruit ripens it acquires its characteristic color and is more easily removed from the plant. Flavor and the degree of softness attained by the fruits are also factors useful in determining the proper time to pick.

Fruit to be shipped to a distant market should be picked in a firm-ripe or slightly immature condition. The actual degree of ripeness depends on the distance and method of shipment. Only experience can determine the time to pick fruit in such circumstances.

Berries should, if possible, be picked in early morning, after the dew has dried off, and be placed immediately in a cool place out of the sun.

Pickers should be given special instructions to handle the berries carefully at all times. Rough handling causes bruising that will seriously reduce the keeping quality of the fruit. A minimum of about 5 to 6 pickers are usually required to harvest berries from an acre of small fruits. The price paid for picking berries

varies from year to year, and with the abundance and size of berries in the planting. Some growers pay pickers approximately 20 per cent of the wholesale selling price of the fruit. As berries become smaller and more difficult to pick late in the season, the price may be increased.

GRADING AND PACKING

If the berries are to be sold as a fancy product, they should be graded to remove the poorer specimens. In most cases, this can be done most efficiently by the pickers as the fruit is harvested in the field. All small, misshapen and injured berries should be placed in a separate box in the tray or carrier that holds the boxes into which the picker is placing the fruit. If pickers are paid by the basket, they must receive credit for these cull berries as well as the marketable fruit.

Packages for berries should be attractive, sufficiently strong to protect the fruit, economical in price, and of a convenient size and shape. A cellophane cover over the individual baskets of berries protects the contents and makes the package more attractive. Cellophane for such covers may be secured from dealers who sell berry baskets and crates. These protective caps are usually held in place by an elastic band that snaps around the box just below the rim.